

Analytical Dynamics I

EML 5215 Sections 2FED, OVER, 1FE2, & CAMP

Class Periods: Monday, Wednesday, Friday, Period 9, 04:05pm-04:55pm

Location: NEB 102

Academic Term: Fall 2025

Instructor:

Alicia K. Petersen

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Office: NEB 441

Office Hours

Virtual & In-Person Office Hours 1.5 hours/week, TBD (See CANVAS for posted times.)

Course Description

Analytical methods of statics and dynamics. Principle of virtual work, holonomic and non-holonomic constraints. Lagrange equations for constrained and unconstrained systems, conservation laws, stability analysis by perturbation about steady state, Jacobi first integral, generalized impulse and momentum. (3 Credit Hours)

Course Pre-Requisites / Co-Requisites

Dynamics (EGM 3401 or equivalent or with instructor permission.) A fundamental knowledge of vector dynamics, matrix algebra, and computer programming skills.

Course Objectives

The objective of this course is to cover fundamental principles and provide a thorough and systematic introduction to the subject of dynamics of particles and rigid bodies from Newton-Euler and analytical mechanics perspectives. This course emphasizes a first-principles approach to the development of theory and its application to a range of problems of interest. The primary learning objective is for students to be able to model multibody mechanical systems and derive their equations of motion for a range of applications and assumptions.

Materials and Supply Fees

None.

Required Resources and Software

- MATLAB and/or Python may be required for some assignments.
- Additional resources will be available on the CANVAS course page.

Recommended Textbooks

- Dynamics of Particles and Rigid Bodies: A Systematic Approach
Anil V. Rao
Cambridge University
2006 Edition
ISBN: 9780521187909
- Engineering Mechanics: An Introduction to Dynamics
David J. McGill and Wilton W. King
PWS Publishing
1995, 3rd Edition
ISBN: 9780534933999
- Vector Mechanics for Engineers: Dynamics
Ferdinand Beer and E. Russell Johnston, Jr.
WCB McGraw-Hill

1997, 6th Edition
ISBN: 9781266709197

Or another dynamics textbook that works well for you. I do advise finding a print resource that you can use as a reference.

Additional Practice Problems: Feel free to use additional outside resources online or in textbooks to practice dynamics problems, there are a lot of resources out there, some with great practice problems, just be careful with varying forms of mathematical notation. This could be a great chance to find dynamics applications specific to your research area.

Required Computer

UF student computing requirement: <https://news.it.ufl.edu/education/student-computing-requirements-for-uf/>
MAE student computing requirement: <https://mae.ufl.edu/students/undergraduate/computer-requirements/>

Graded Assignments

Homework Assignments:

Homework sets are meant to give practice applying the course content to a variety of problems relevant to Mechanical and Aerospace Engineering. Throughout these assignments students will be graded based on a mix of problem set-up, process, mathematical calculations, implementing dynamics in code, drawing conclusions, and extending course concepts to new scenarios, as well as accuracy. Throughout the course these homework sets will typically be assigned on a 1-2 week frequency.

Lecture Quizzes:

Lecture quizzes are meant to be a check-in to test your top-level understanding of key concepts from the lectures. They are typically due one week following the relevant lecture. They are typically multiple choice or fill-in-the-blank questions. There are typically 1-2 lecture quizzes per week.

Interactive Activities:

Interactive activities for this course will be assigned in a few formats. Some will be graded, while some will be graded for completion/effort. Sometimes these may be a guided dynamics problem worked on during class in small groups, sometimes as a guided worksheet done alone to deepen understanding of key concepts, sometimes as a coding tutorial, sometimes as a small assignment in small groups outside of class time. Some of these activities may be graded for effort, others for accuracy, or a combination thereof. Different sections of the course may be given different versions of these activity assignments to be completed in different formats.

AI Policy - Some AI:

Generative AI tools may be used to enhance **some** assignments in this course. Assignment instructions will differentiate between distinct human and AI tasks. Any and all work that is done using generative AI must be cited in your submission. For any assignment without explicit AI use in its instructions, no use of generative AI is permitted.

Course Schedule (Subject to change.)

Weeks 1-2	Introductory Concepts
Weeks 3-7	Kinematics and Kinetics of Particles
Weeks 8-12	Kinematics and Kinetics of Rigid Bodies
Weeks 12-16	Lagrangian Dynamics, Special Topics and more

Important Dates (Subject to change.)

10/08/25	Exam 1 (Weeks 1-7): In-Class Portion (04:05pm-04:55pm, NEB 102) for all Sections
11/14/25	Group Project Due
12/03/25	Last Homework/Activity Assignment(s) Due
12/10/25	Final Exam (5:30pm-7:30pm, NEB 102)

Attendance Policy, Class Expectations, and Make-Up Policy

Section CAMP only: Regular in-class attendance is expected. In-class activities may be required and graded for credit, which may or may not be announced ahead of time. Make-up activities will be available for some prior approved absences. Additional accommodations or make-up activities will be accommodated only at instructor discretion.

When in class, all personal communication devices should be off or set to silent.

Homework assignments will be accepted with a 50% penalty if submitted within 24 hours after the deadline. This applies only to assignments in the "Homework Assignments" category on CANVAS. Any additional accommodations will be considered only on a case-by-case basis.

Students are expected to have access to a personal computer and regularly monitor both email and CANVAS for class communications.

If students have a planned absence of academic relevance or otherwise, reach out to instructor directly, via direct message on CANVAS more than one week ahead for any requested accommodations or extensions. Face-to-face conversations, while welcome, do not replace written notification. For emergency and medical absences, please notify instructor via CANVAS prior to the missed class times for notification and requested accommodations or extensions. Any requested accommodations or extensions will be assessed on a case-by-case basis with a concerted effort towards equity. Types of requests which, for example, will be given consideration on a case-by-case basis may include: illnesses due to communicable viruses, research conference travel, university sports competitions, or funeral services, to name a few.

Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation. Additional information can be found here: <https://gradcatalog.ufl.edu/graduate/regulations/>.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework (3-6) & Interactive Activities (5-10)	variable value	35%
Lecture Quizzes (10-20)	100 each	15%
Exam 1	100	15%
Projects	100	15%
Final Exam	100	20%
		100%

Subject to change.

Grading Policy

Percent	Grade	Grade Points
93.34 - 100	A	4.00
90.0 - 93.33	A-	3.67
86.67 - 89.99	B+	3.33
83.34 - 86.66	B	3.00
80.00 - 83.33	B-	2.67
76.67 - 79.99	C+	2.33
73.34 - 76.66	C	2.00
70.00 - 73.33	C-	1.67
66.67 - 69.99	D+	1.33

63.34 - 66.66	D	1.00
60.0 - 63.33	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates

academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Cheating and academic dishonesty are not tolerated in this course and are subject to penalties, including but not limited to a zero on the assignment, be subject to academic dishonesty policies. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://elearning.ufl.edu/>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.